United States Patent [19]

Rosenberg et al.

[11] **Patent Number: 4,564,303**

[45] **Date of Patent: Jan. 14, 1986**

[54] **NONTILTABLE, STRAIGHT LINE PATH RIBBON CARTRIDGE SHIFTING MEANS FOR MULTICOLOR RIBBON INCLUDING MICR INK**

[75] Inventors: **Michael J. Rosenberg,** 3327 Euclid Heights Blvd., Cleveland Hts., Ohio 44118; **Alfred C. Erpel,** Doylestown, Pa.

[73] Assignee: **Michael J. Rosenberg,** Cleveland Heights, Ohio

[21] Appl. No.: **502,671**

[22] Filed: **Jun. 9, 1983**

[51] **Int. Cl.**[4] **B41J 32/00**

[52] **U.S. Cl.** **400/208;** 400/105; 400/206.3; 400/212; 400/214; 400/225; 400/227.2; 400/229; 400/235.1

[58] **Field of Search** 400/105, 106, 107, 194, 400/195, 196, 196.1, 206, 206.1, 206.3, 206.4, 207, 208, 208.1, 212, 214, 225, 227.2, 229, 235.1, 240.4, 569

[56] **References Cited**

U.S. PATENT DOCUMENTS

3,595,362	7/1971	Wolowitz	400/216.2
3,618,738	11/1971	Boyatt et al.	400/569 X
3,645,371	2/1972	Jovis	400/212 X
3,904,017	9/1975	Frechette	400/208 X
3,927,746	12/1975	Wolowitz	400/229 X
3,967,790	7/1976	Hess	400/196 X
3,993,182	11/1976	Steinke	400/235.1 X
3,995,731	12/1976	Miller et al.	400/195
4,034,935	7/1977	Plaza et al.	400/208 X
4,302,118	11/1981	Schaefer	400/208
4,329,072	5/1982	Kacmarcik	400/208
4,337,001	6/1982	Cappotto	400/208
4,347,007	8/1982	Schaefer	400/208
4,353,657	10/1982	Schaefer	400/208
4,407,595	10/1983	Gershnow	400/212

FOREIGN PATENT DOCUMENTS

0059923	9/1982	European Pat. Off.	400/208
1611468	5/1979	Fed. Rep. of Germany	400/208
2824454	12/1979	Fed. Rep. of Germany	400/208

OTHER PUBLICATIONS

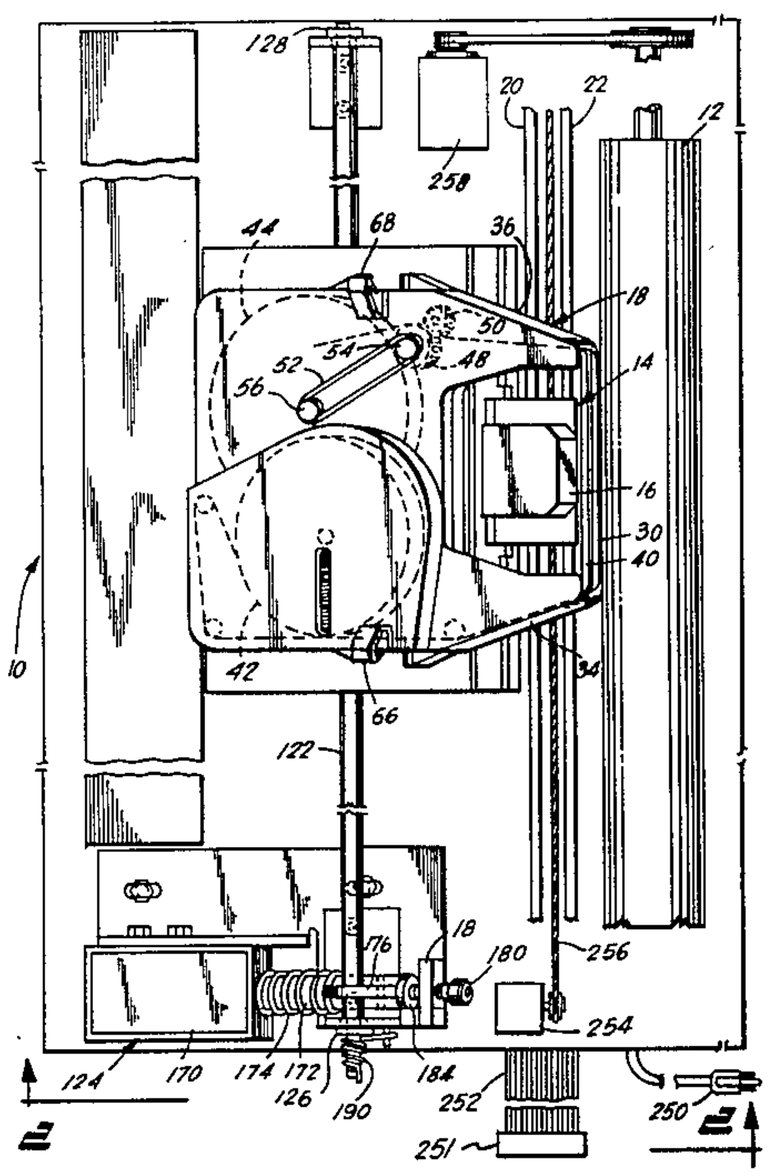
IBM Technical Disclosure Bulletin, "Self-Aligning Ribbon and Tape Drive," Lingle, vol. 26, No. 3A, Aug. 1983, pp. 1157–1158.

Primary Examiner—Ernest T. Wright, Jr.
Attorney, Agent, or Firm—Renner, Otto, Boisselle & Lyon

[57] **ABSTRACT**

A printer for use with a data processor and a ribbon cartridge for use in the same are disclosed. The cartridge has at least two separate ribbon supplies which may differ in the type of ink on the ribbon (MICR vs. ordinary) and/or in color of ink or otherwise. A mechanism moves the cartridge along a straight line path to index selectively an active portion of each of the ribbons to a position aligned between a printhead and a platen for printing through the selected ribbon. A ribbon drive mechanism drives at least one of the ribbon supplies only when that ribbon supply has been selectively indexed to be printed through. In one embodiment a Magnetic Ink Character Recognition ribbon supply is driven between take-up and supply reels only when it is indexed for printing, while a multi-strike ribbon with ordinary ink is driven continuously. In another embodiment only one of two or more ribbon supplies is driven at one time. In both embodiments the straight line movement of the cartridge between indexed positions engages and disengages the drive to the various ribbon supplies by movement of the cartridge along the axis of a ribbon drive shaft.

9 Claims, 13 Drawing Figures



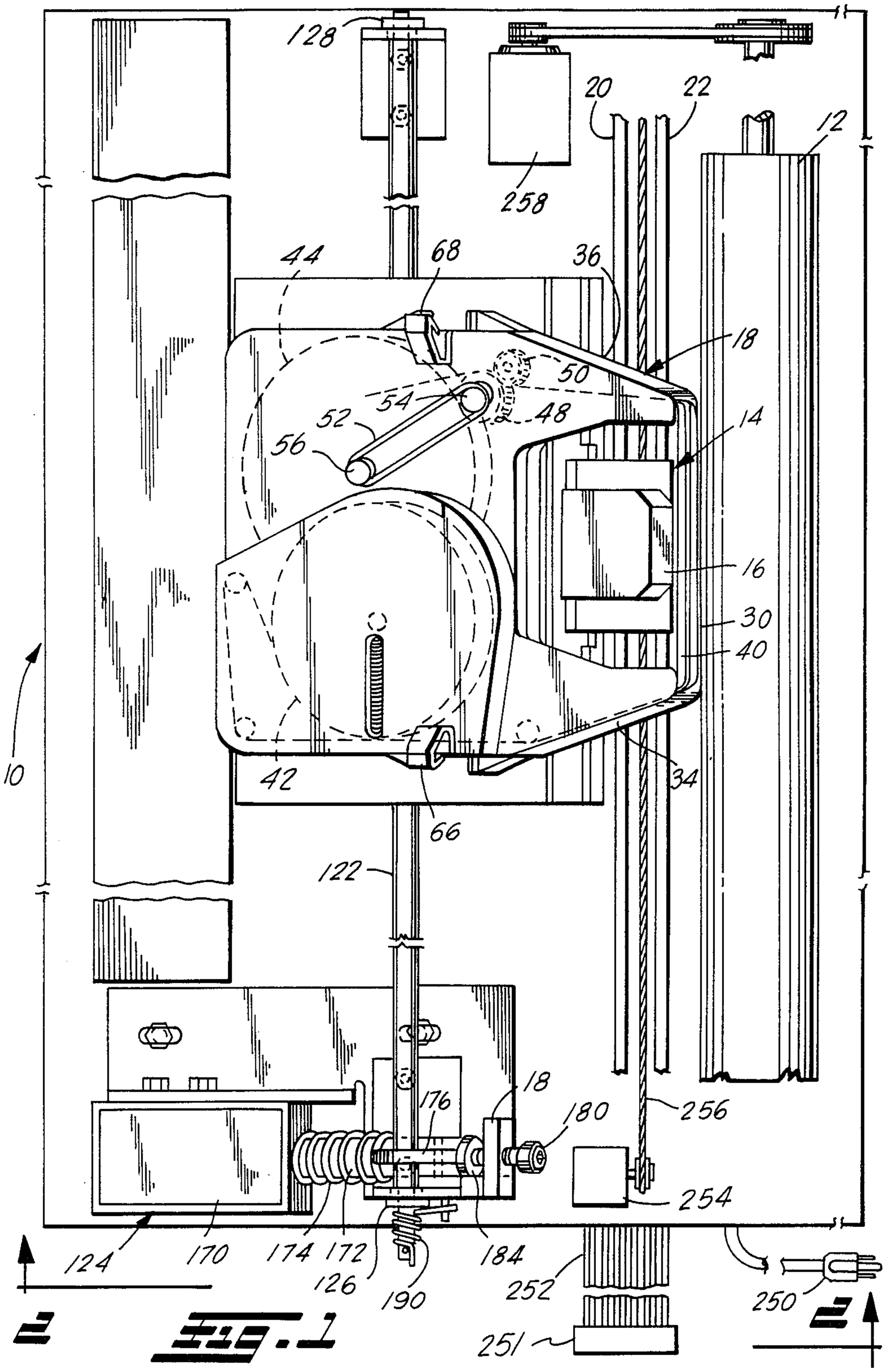

128
131
131
258
20
22
12
44
68
36
18
50
54
48
52
56
14
16
30
40
10
42
34
66
122
18
176
180
256
254
124
170
174
172
126
190
184
252
251
250

Fig. 1

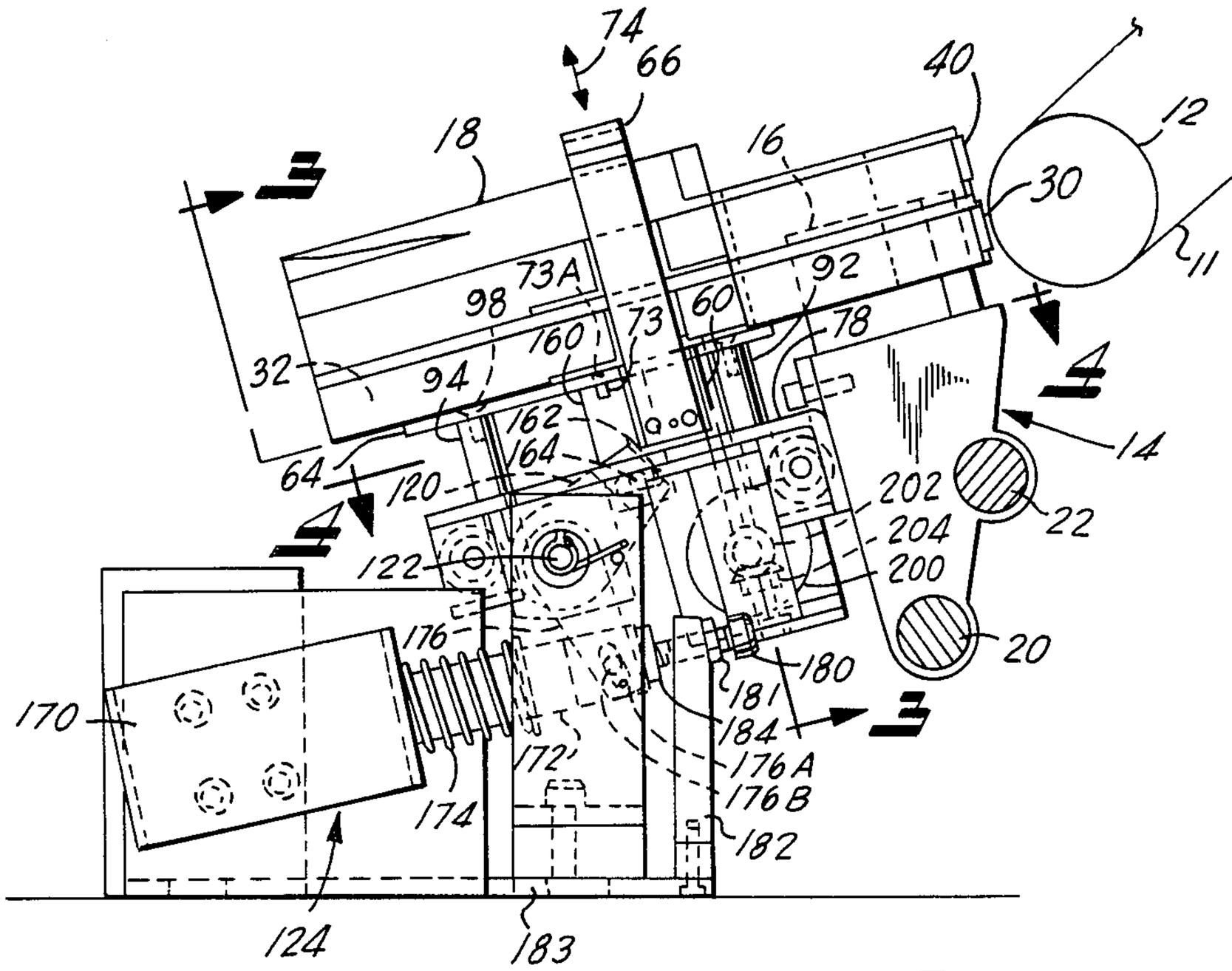

74
66
40
18
16
12
30
3
73A
98
92
60
73
78
160
32
94
4
162
64
14
120
202
204
22
200
122
176
20
180
181
170
184
3
172
176A
176B
174
182
124
183

Fig. 2

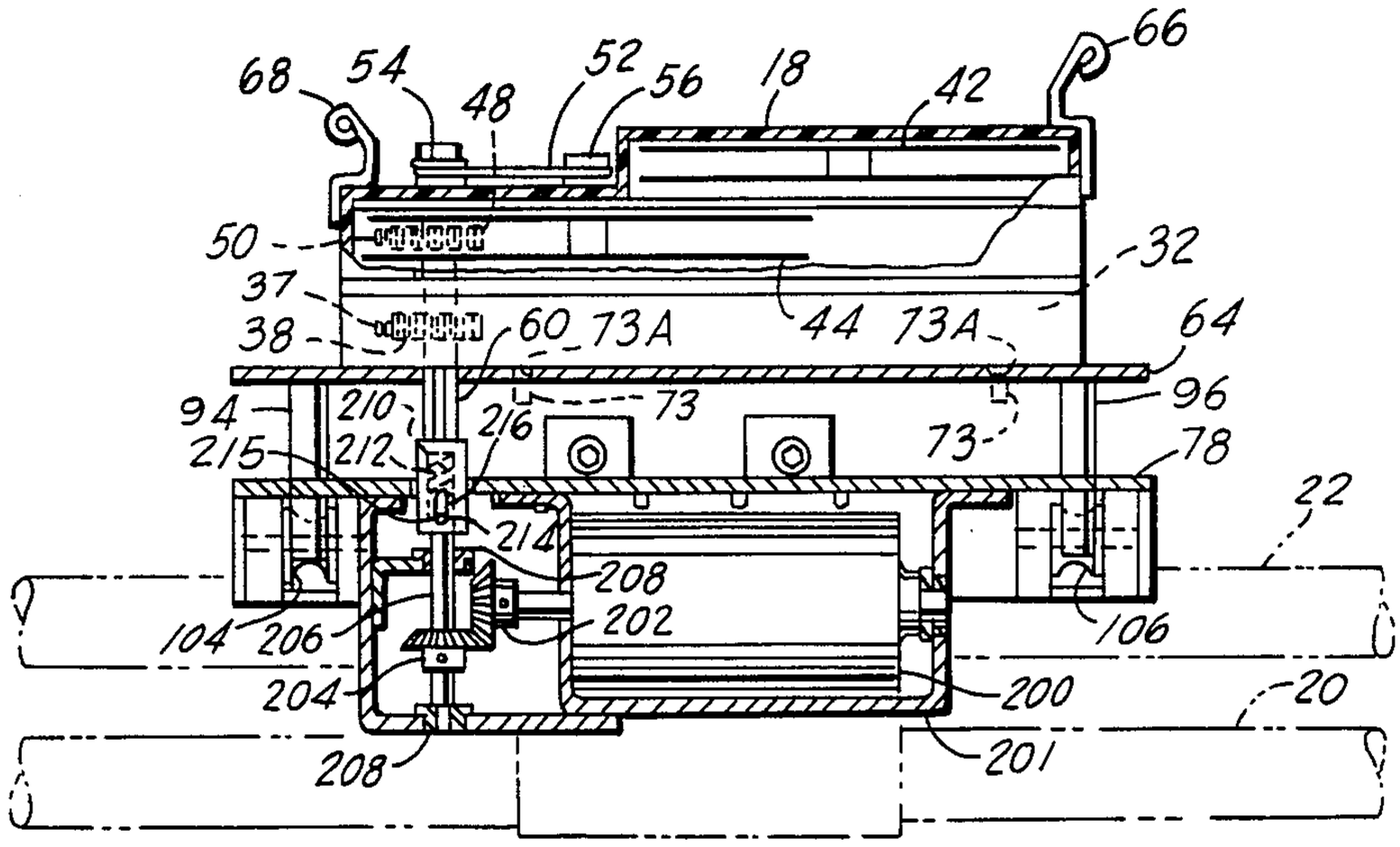

68
54
48
52
56
18
42
66
50
32
37
38
60
73A
44
73A
64
94
210
216
73
96
215
212
73
78
214
22
208
104
206
202
106
204
200
20
208
201

Fig. 3

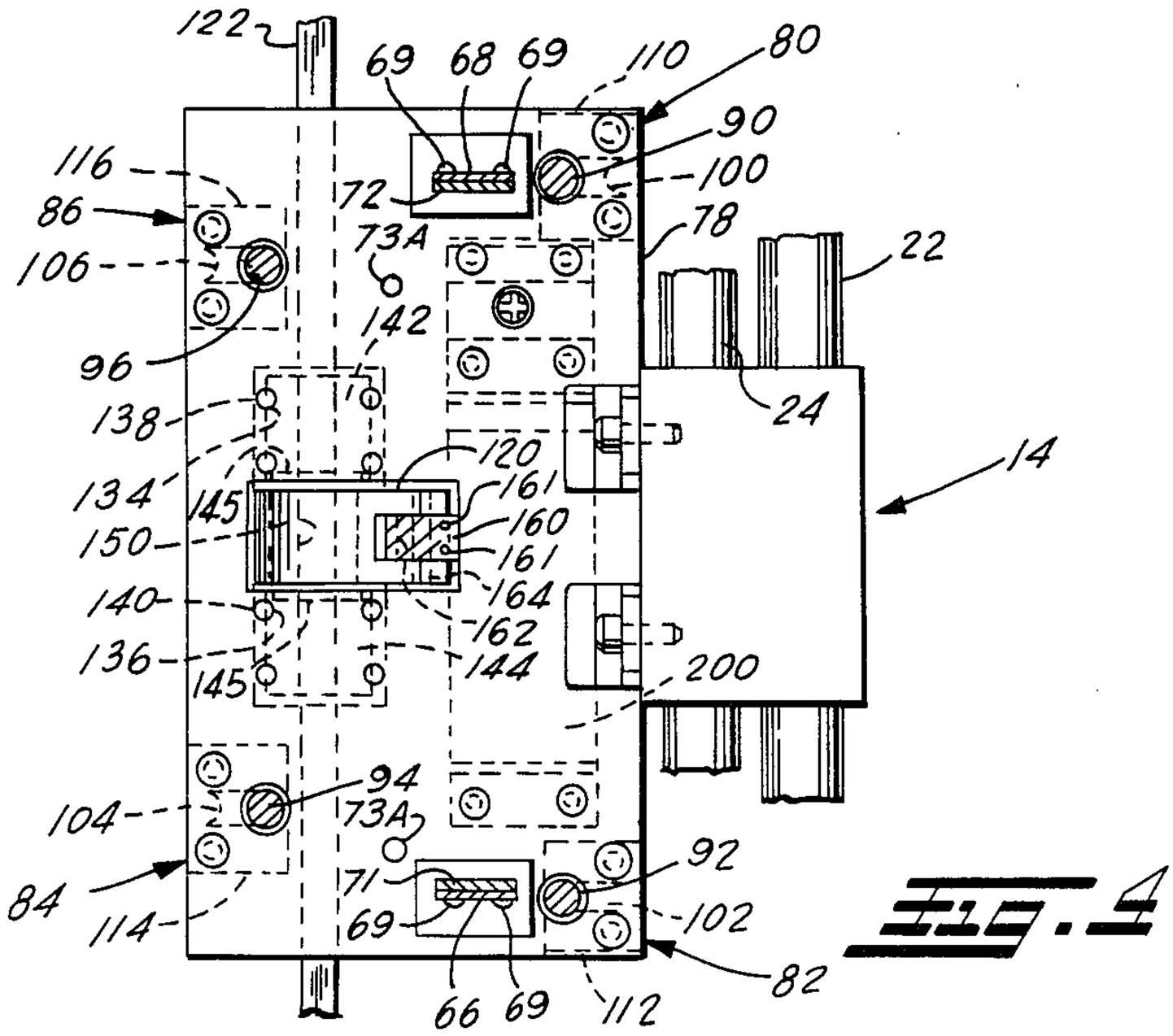


Fig. 4

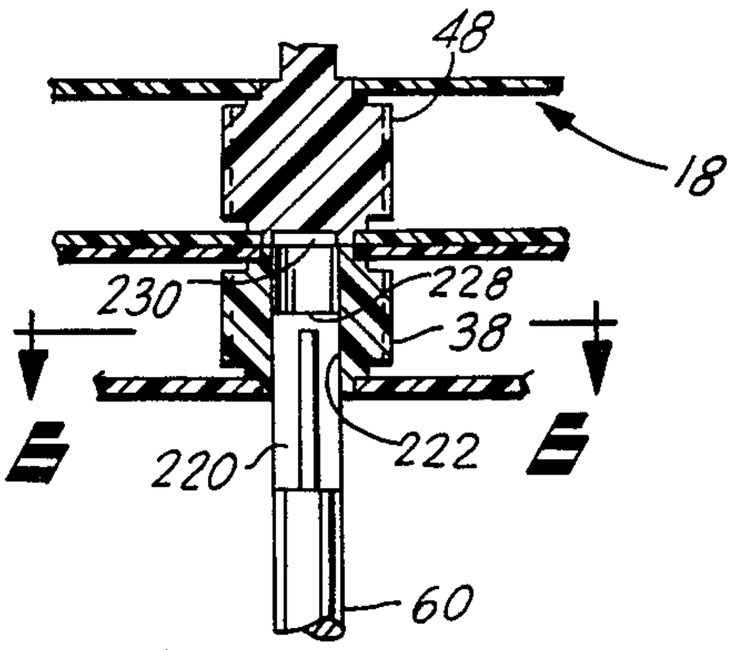


Fig. 5A

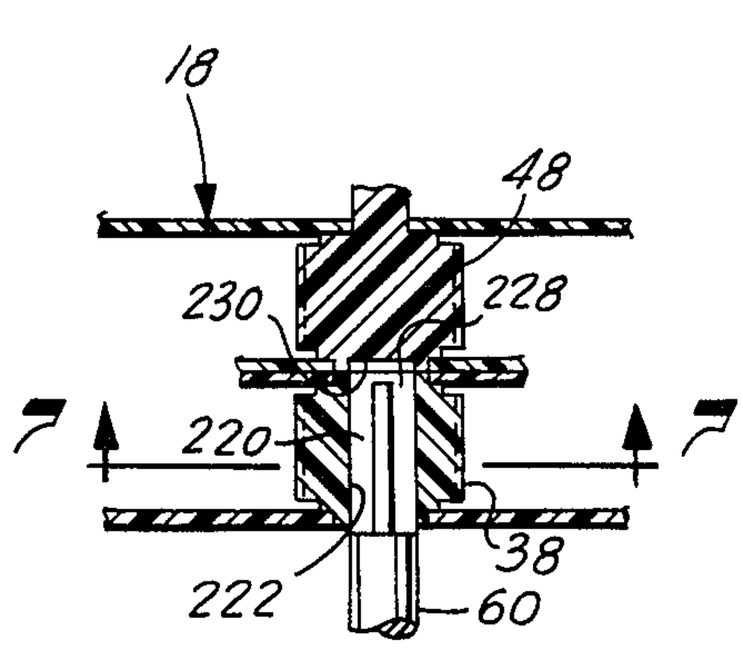


Fig. 5B

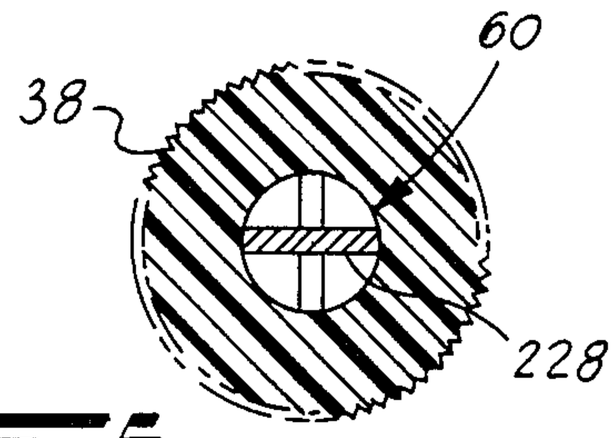


Fig. 6

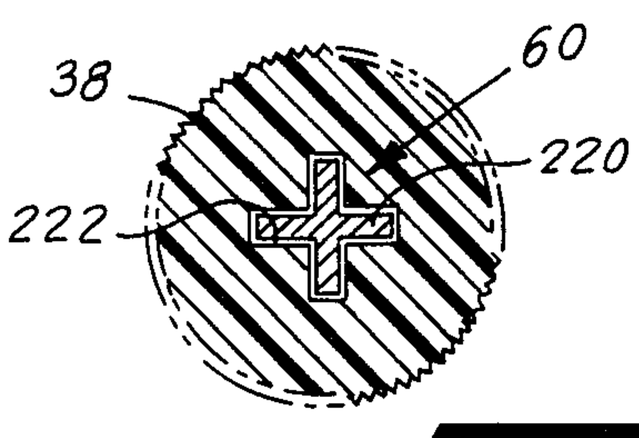


Fig. 7

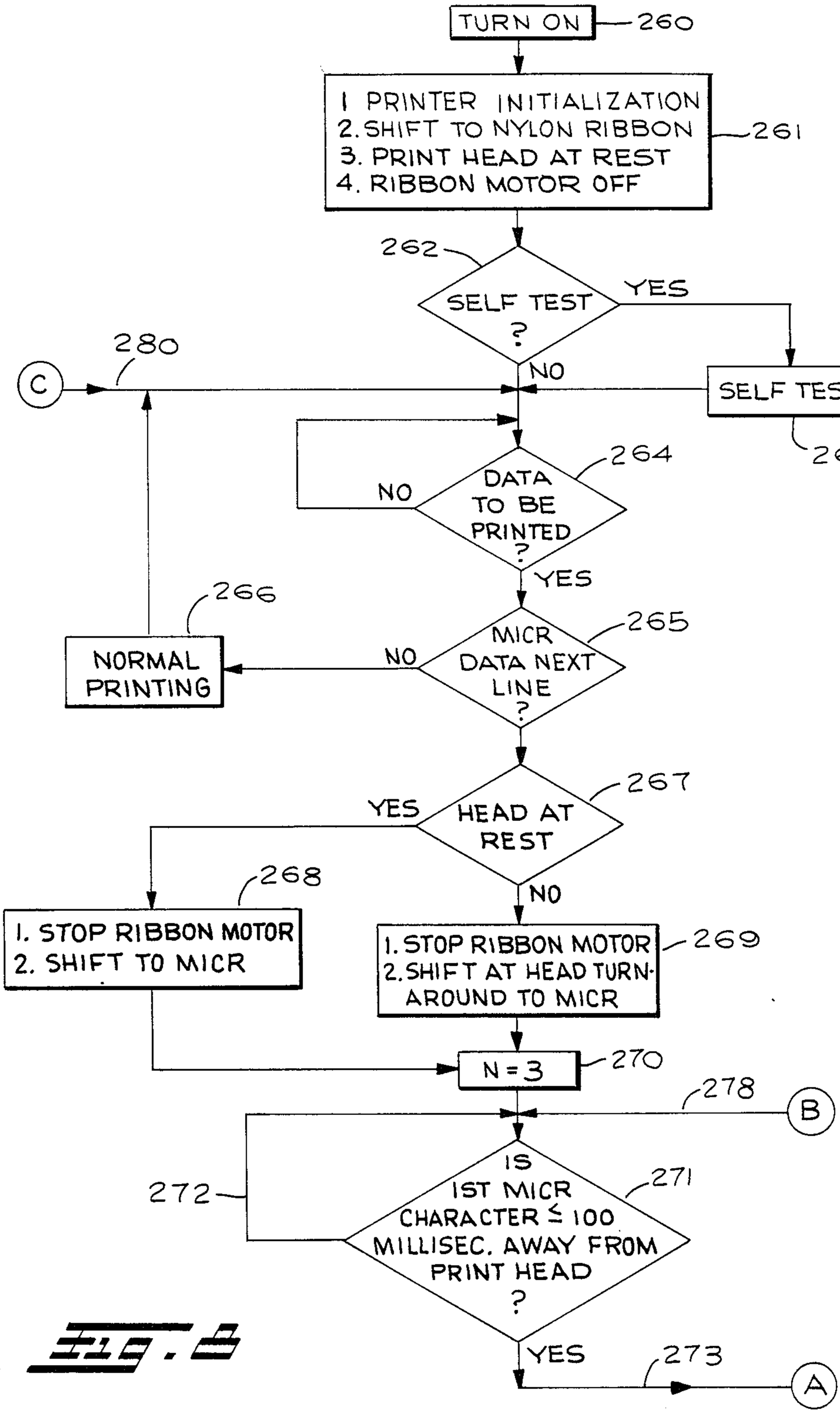

TURN ON
260
1 PRINTER INITIALIZATION
2. SHIFT TO NYLON RIBBON
3. PRINT HEAD AT REST
4. RIBBON MOTOR OFF
261
262
SELF TEST ?
YES
NO
SELF TEST
263
280
C
264
DATA TO BE PRINTED ?
NO
YES
265
MICR DATA NEXT LINE ?
NO
266
NORMAL PRINTING
267
HEAD AT REST
YES
NO
268
1. STOP RIBBON MOTOR
2. SHIFT TO MICR
269
1. STOP RIBBON MOTOR
2. SHIFT AT HEAD TURN-AROUND TO MICR
270
N = 3
278
B
272
271
IS 1ST MICR CHARACTER ≤ 100 MILLISEC. AWAY FROM PRINT HEAD ?
YES
273
A

Fig. 8

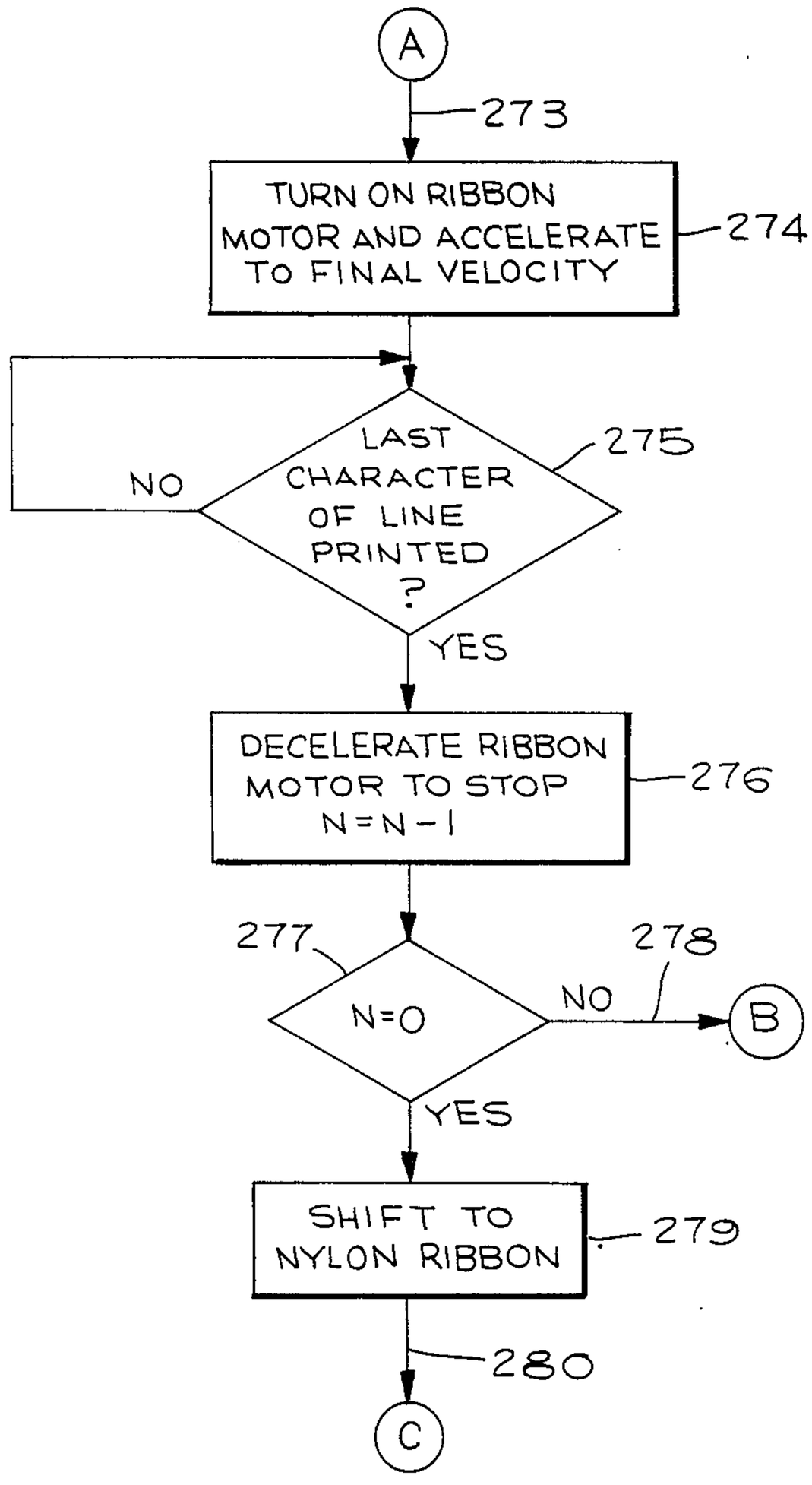

A
273
TURN ON RIBBON MOTOR AND ACCELERATE TO FINAL VELOCITY
274
LAST CHARACTER OF LINE PRINTED ?
275
NO
YES
DECELERATE RIBBON MOTOR TO STOP N=N-1
276
277
N=0
278
NO
B
YES
SHIFT TO NYLON RIBBON
279
280
C

Fig. 5

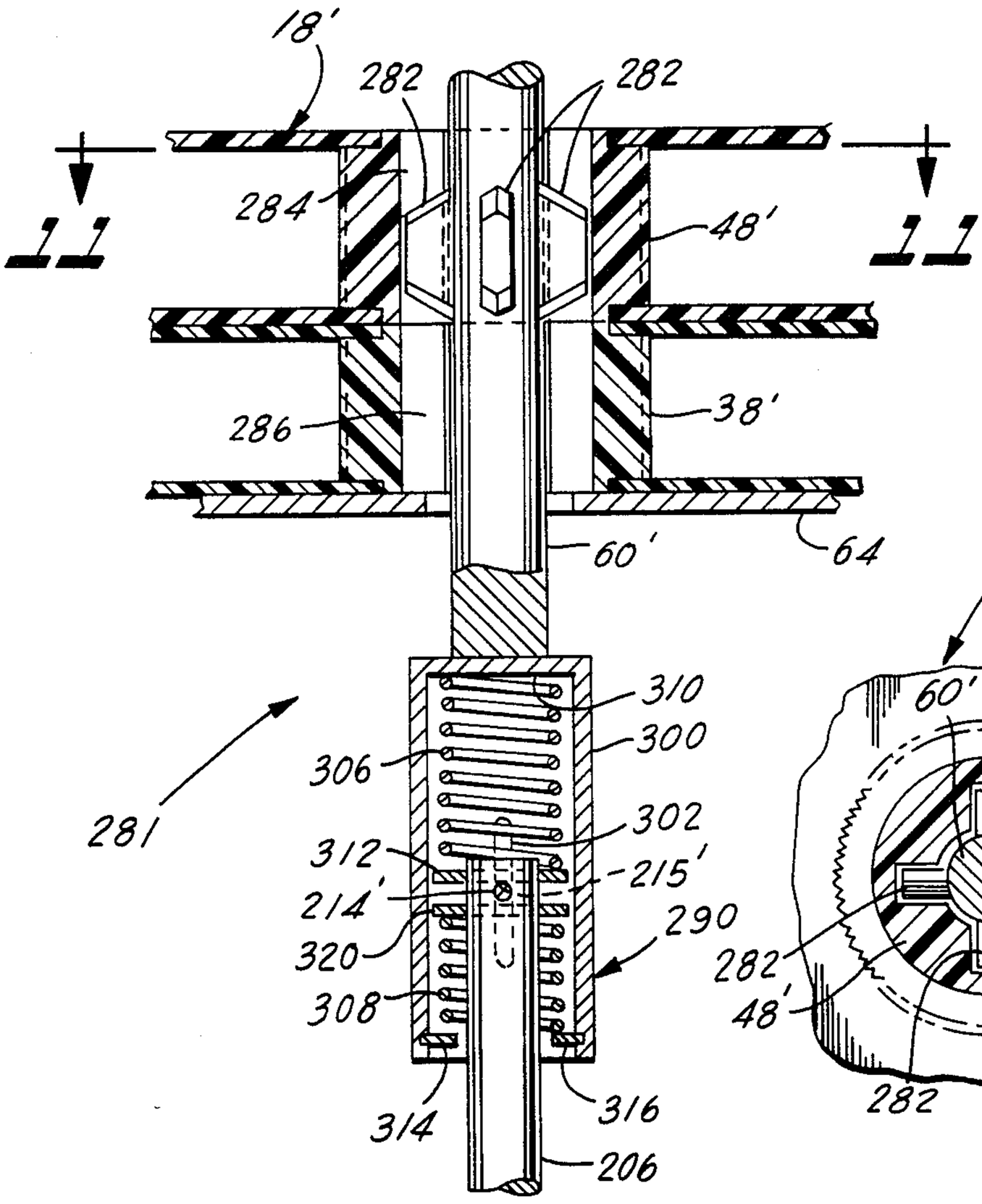


Fig. 10

Fig. 11

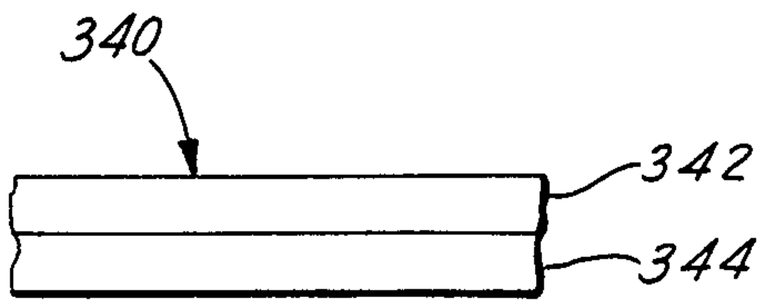


Fig. 12

NONTILTABLE, STRAIGHT LINE PATH RIBBON CARTRIDGE SHIFTING MEANS FOR MULTICOLOR RIBBON INCLUDING MICR INK

BACKGROUND OF THE INVENTION

The present invention relates to printers, especially those for data processing equipment, and particularly to a dot matrix printer which prints characters in either of two or more inks and to a cartridge having a plurality of ribbons each with a different ink suitable for use in such a printer. The invention also relates to improvements for printers to enable facile use of multiple ribbons. The invention also relates to a method of printing materials, such as checks, requiring different inks, such as standard and MICR type inks.

In the past, printers used with data processing equipment were capable of printing with only a single ribbon at one time. For some printing jobs this has proven inconvenient. For example, when printing payroll checks the bulk of the information printed on the check may be printed with ordinary ink and any normal typeface. The name of the issuer, the issuer's bank, the date and the payee may be so printed. However, checks also must include certain information printed in a special typeface with magnetic (MICR-Magnetic Ink Character Recognition) ink. Such information includes a bank identification number, a check number and an amount.

MICR ink is substantially more expensive than ordinary ink. Additionally, MICR inked ribbons for high speed printers are single strike ribbons, which, unlike the ribbon used with ordinary ink, e.g. fabric ribbons, may not be circulated past the printhead more than one time. The result is that MICR ribbon cartridges must be replaced after many fewer characters have been printed than comparable ordinary ribbon cartridges and at a greater cost. Therefore, it has not proven economical to print entire checks with MICR ink.

The past practice when printing payroll checks has been to preprint the bank identification number and check number in MICR ink and typeface on the check blanks; or this process may involve using a separate printer, e.g. a daisy wheel printer or MICR encoder, either before or after the non-MICR information has been printed on the checks, but in any event in a separate operation and normally without amount information. In a separate printing operation, or in the same operation but with different ink, the issuer's name and bank are also printed on the check blank. Then the check blank is run through a printer which may be controlled by a data processor to print in ordinary ink the date, the payee's name, and the amount of the check. The first bank to receive the check then must read the amount of the check and add to the check blank the dollar amount in MICR characters and ink.

Another prior process for placing MICR information, e.g. relating to bank identification number, account number, and sequence number, may be carried out using a separate MICR encoding machine. Moreover, heretofore a typical check is not encoded with amount information until it reaches the first bank for clearing, payment, etc.; at such bank an MICR encoding (proof) machine is used to apply such amount information to enable subsequent automatic reading and/or handling of the check.

The process of issuing and processing checks such as payroll checks would be greatly simplified if a single printer could print all the data on the front of the check, using either ordinary or MICR inks and typefaces as required. Likewise the processes of encoding MICR information on documents other than checks and of printing multiple information on such documents would be greatly simplified, according to the present invention, e.g. by using only a single prior and multiple ribbon capability thereof.

SUMMARY OF THE INVENTION

The present invention provides such a printer improvement and, in particular, a printer for use in conjunction with a data processor. The printer can print selectively with either of two or more ribbons. The invention also includes a ribbon cartridge for use in such a printer. The printer includes a conventional dot matrix printhead and a rotatable platen. The printhead is mounted on a carriage assembly for reciprocating movement along a path parallel to the axis of the platen. The carriage assembly also carries a ribbon cartridge having a supply of two or more different ribbons, an active portion of each of the ribbons being positionable between the printhead and the platen for printing on a web or other sheet material.

The ribbon cartridge includes a plurality of different ribbon supplies driven by a common drive motor. In one embodiment there are two ribbon supplies, one a supply of multi-strike ribbon inked with ordinary ink and the other a supply of single-strike ribbon inked with MICR ink. The multi-strike ribbon is randomly stuffed in a cavity in the lower portion of the cartridge, and the active portion thereof is pulled past the printhead by a pair of opposed drive wheels frictionally engaging opposite sides of the ribbon. The single-strike MICR ribbon is supplid wound on a supply reel and is wound onto a separate take-up reel located between the supply reel and the random storage cavity. The MICR ribbon is pulled along a path with an active portion immediately above the active portion of the multi-strike ribbon. An opposed pair of drive wheels pulls the MICR ribbon. One of the MICR drive wheels is coaxial with one of the multi-strike ribbon drive wheels.

The ribbon drive is arranged to drive selectively at least one of the ribbon supplies. In practice, the MICR ribbon is not driven when the printhead is aligned with the active portion of the multi-strike ribbon. Instead, the MICR ribbon is driven only when the printhead is aligned with the active portion of the MICR ribbon to print magnetically readable characters. The selective driving of the MICR ribbon prolongs the time between ribbon cartridge changes.

A mechanism is provided for shifting the cartridge between a first operating position in which the active portion of one of the ribbons is aligned between the printhead and the platen and a second operating position in which the active portion of the other ribbon is so aligned. In cartridges having three or more ribbons, a corresponding number of positions are provided. The shifting mechanism provides for straight line movement, as opposed to a rocking or tilting movement, of the cartridge along a straight line path normal to a plane containing the platen axis and in the common plane of the active portions of the ribbons. The straight line movement facilitates the selective drive of the MICR ribbon and accurate ribbon alignment with respect to the printhead and platen. Specifically, the drive wheel for the multi-strike ribbon is driven by a fluted shaft which extends through the center thereof. The multi-

strike ribbon drive wheel is axially slidable along the shaft as the cartridge shifts between operating positions. In one of the operating positions the shaft engages and drives the drive wheel for the MICR ribbon as well as the multi-strike ribbon drive wheel. In the other operating position, the shaft is free of contact with the MICR ribbon drive wheel and so does not drive it. In this way movement of the cartridge between operating positions automatically engages and disengages drive to the more expensive and non-reusable MICR ribbon.

The ribbon cartridge travels with the printhead. This minimizes ribbon, particularly the MICR ribbon, used during operation of the printer.

The arrangement of the components is also designed to minimize the mass which must move vertically when shifting between one operating position and the other and to minimize the mass that reciprocates laterally with the carriage assembly along the length of the platen as each line is printed. The ribbons are both driven by a single electric motor which is connected to the reciprocating carriage. This motor does not move vertically when the cartridge is shifted between operating postions. Instead, the cartridge moves up and down sliding on the ribbon drive shaft which is driven by the electric motor. This not only selectively engages and disengages the MICR drive wheel as discussed above, but also allows reduced weight by using only a single motor and promotes faster shifting between operating positions because the motor itself does not move.

The cartridge is shifted between operating positions by a solenoid which is remote from the cartridge. The solenoid is fixed to the printer frame and, through a crank arm, rotates a square shaft. The square shaft in turn operates a second crank arm which is slidable along the shaft as the carriage moves. The cartridge is mounted on linear bearings in the carriage and moves up and down in a straight line path when the second crank arm is rotated by actuation of the solenoid. This arrangement reduces the mass which reciprocates laterally, thereby speeding printing and reducing power consumption, vibration and wear.

A method in accordance with the present invention effects selective printing of different portions of the medium with MICR ink and with non-MICR ink. The method includes aligning a ribbon carrying non-MICR ink with respect to a printhead and with respect to such medium and printing selected portions of such medium with ink from such first ribbon. As desired, the first ribbon is moved out from such alignment and a second ribbon containing MICR ink is aligned with respect to such printhead and such medium and selected other portions of such medium are printed using ink therefrom. Preferably such medium is a check.

Accordingly it is an object of the invention to enable a printer to shift between printing with any of two or more ribbons.

It is a further object of the invention to provide a ribbon cartridge with a plurality of ribbon supplies, and particularly with one of the ribbon supplies being MICR ribbon.

It is a further object of the invention to provide a printer which can shift between printing with any of two or more ribbons.

It is a further object of the invention to provide a ribbon cartridge in which ribbon drive wheels for each of a plurality of ribbon supplies are coaxially aligned.

It is a further object of the invention selectively to drive one or more of the ribbon supplies of a printer depending on which ribbon is shifted into a printing position.

It is a further object of the invention selectively to shift a ribbon into a printing position by moving a ribbon cartridge assembly along a straight line path normal to a plane containing the platen axis and in a plane common to the active portions of the ribbons.

It is a further object of the invention to minimize inertia in a printer shift mechanism.

It is a further object selectively to print different portions of the medium in MICR ink and in non-MICR ink, especially with such medium being a check.

The invention, then, comprises the features hereinafter fully described and particularly pointed out in the claims, the following description and annexed drawings setting forth in detail certain illustrative embodiments of the invention, these being indicative, however, of but a few of the various ways in which the principles of the invention may be carried out.

BRIEF DESCRIPTION OF THE DRAWINGS

In the annexed drawings:

FIG. **1** is a plan view of a printer and cartridge constructed in accordance with the present invention;

FIG. **2** is an elevation view looking in the direction of arrows **2—2** of FIG. **1**;

FIG. **3** is a sectional view taken along the line **3—3** of FIG. **2**;

FIG. **4** is a view in the direction of arrows **4—4** of FIG. **2**;

FIGS. **5A** and **5B** illustrate two operating positions of the mechanism of FIGS. **1–4**;

FIG. **6** illustrates a portion of the mechanism shown in FIG. **5A** viewed in the direction of arrows **6—6**;

FIG. **7** illustrates a portion of the mechanism shown in FIG. **5B** viewed in the direction of arrows **7—7**;

FIGS. **8** and **9** are flow charts indicating operation of the printer in accordance with the present invention with respect to a computer or data processing control/-drive system therefor;

FIG. **10** illustrates another embodiment of the portion of the printer shown in FIGS. **5A–7**;

FIG. **11** is a view looking in the direction of arrows **11—11** of FIG. **10**; and

FIG. **12** is a fragmentary view of a ribbon having two bands of different ink.

DESCRIPTION OF PREFERRED EMBODIMENTS

FIG. **1** illustrates a printer **10** constructed in accordance with the present invention for use with a data processor. In use, a web **11** (FIG. **2**, not shown in FIG. **1** for clarity) such as blank payroll checks is fed around platen **12** and the printer **10** prints thereon. A carriage assembly **14** includes a printhead **16** and a ribbon cartridge assembly **18**. The carriage assembly **14** moves along rails **20** and **22** parallel to the axis of the platen **12** to print each line on the web **11**. When a line of print is completed, the platen **12** is rotated to advance the web **11** and a succeeding line is printed. The printer **10** is a high speed printer, for example, capable of printing about 600 characters per second, or about 250 lines per minute, at least where characters are formed by a single pass or traverse of the printhead **16**. An exemplary printer is one sold by Florida Data Inc.

Printing commonly occurs while the carriage assembly **14** is moving in either direction. When using a dot matrix printhead **16** to print some typefaces, it may

require more than a single pass of the printhead **16** to print an entire line. For example, two passes may be required to form MICR (magnetic ink character recognition) characters with a dot matrix printhead **16**. Other types of printheads, such as the so-called daisy wheel printheads, do not require more than a single pass, but these are slower than the dot matrix printhead **16**, and not suitable for use in high speed printers.

The ribbon cartridge assembly **18** (FIGS. **2** and **3**) carries a supply of two different ribbons **30**, **40**. The lower one-third portion of the cartridge assembly **18** carries an ordinary ribbon **30** which is randomly stuffed in a conventional manner inside a chamber **32**. The ribbon **30** is multi-strike ribbon formed of a fabric impregnated with ink. The cartridge assembly **18** includes a pair of arms **34** and **36** (FIG. **1**) which support the ribbon **30** so that an active portion thereof moves in a straight line along a path between the printhead **16** and the platen **12** so that the printhead **16** may strike through the ribbon **30** to print on the web **11**. Drive wheels **37** and **38** frictionally engage opposite sides of the ribbon **30** to pull it along its path.

The cartridge assembly **18** (FIGS. **2** and **3**) also carries a supply of MICR ribbon **40**. The MICR ribbon **40**, because it is used only once, is carried on a supply reel **42** and wound onto a take-up reel **44**. As seen in FIGS. **1** and **3**, the supply reel **42** is positioned above and to one side of the take-up reel **44**, the two together occupying approximately the upper two-thirds of the cartridge assembly **18**.

The MICR ribbon **40** is also guided by arms **34** and **36** (FIG. **1**) to travel on a path having an active portion in which the ribbon **40** is held coplanar with, parallel to, and above the active portion of the ribbon **30**. The MICR ribbon **40** is pulled along from the supply reel **42** to the take-up reel **44** by a pair of opposed drive wheels **48** and **50** which engage opposite sides of the MICR ribbon **40**. The take-up reel **44** is driven by a belt **52** which passes around the shaft **54** on which the wheel **48** is mounted and around a stub shaft **56** connected with the take-up reel **44**. Slippage between the belt **52** and the shafts **54** and **56** accommodates the changing rate at which the take-up reel **44** must turn as the amount of ribbon **40** wound thereon increases.

The drive wheel **48** (FIG. **3**) is located in vertical alignment with the drive wheel **38**. As will become clear from what follows, a single ribbon drive shaft **60** may be used to drive both drive wheels **38** and **48** and thus to pull both ribbons **30** and **40** through the active portion of their respective paths.

The cartridge assembly **18** is secured to a generally planar cartridge mounting plate **64** (FIGS. **2** and **3**) by means of spring clips **66** and **68**. The spring clips **66** and **68** are secured by means of rivets or suitable screws **69** (FIG. **4**) to tabs **71** and **72**, respectively, which extend downward from the bottom of cartridge mounting plate **64**. The cartridge assembly **18** is provided with locating pins **73** which extend through openings **73A**(FIGS. **2** and **3**) formed in the appropriate locations in the cartridge mounting plate **64**. Together, the locating pins **73**, the cooperating openings **73A** in the cartridge mounting plate **64**, and the spring clips **66** and **68** serve to position the ribbon cartridge assembly **18** accurately on the cartrdige mounting plate **64**.

The cartridge mounting plate **64** (FIG. **2**) is carried by the carriage assembly **14** and is mounted for straight line movement in a direction normal to a plane which contains the rotational axis of the platen **12** as indicated by arrow **74** and parallel to the common plane of the active portions of ribbons **30** and **40**. Movement in the direction of arrow **74** moves the cartridge assembly **18** between a first operating position (shown) in which the active portion of the ribbon **30** is located between the printhead **16** and the platen **12** and a second operating position in which the active portion of the MICR ribbon **40** is located between the printhead **16** and the platen **12**. Further, this movement also causes selective engagement of the ribbon drive shaft **60** with the drive-wheel **48** (FIGS. **1** and **3**) which pulls the MICR ribbon **40**.

The cartridge assembly **18** and cartridge mounting plate **64** are mounted for straight line movement in the direction of arrow **74** with respect to the carriage assembly **14**. Specifically, the carriage assembly **14** includes a carriage plate **78** (FIG. **2**) which extends parallel to the major plane of the cartridge assembly **18** and to the axis of platen **12**. Four linear bearing assemblies **80**, **82**, **84**, and **86** (FIG. **4**) connect the carriage plate **78** with the cartridge mounting plate **64** to facilitate smooth straight line movement of the cartridge mounting plate **64** toward and away from the carriage plate **78**.

Each of the linear bearing assemblies **80**, **82**, **84**, and **86** includes a straight cylindrical guide rail **90**, **92**, **94**, and **96** whose axes are all parallel to the common plane of the active portions of the ribbons **30** and **40** and normal to the plane of the cartridge mounting plate **64**. Each of the guide rails **90**, **92**, **94**, and **96** is fastened to the cartridge mounting plate **64** by suitable means such as a countersunk threaded fastener (one shown at **98** in FIG. **2**). Each linear bearing assembly **80–86** also includes a rotatably mounted nylon wheel **100**, **102**, **104**, and **106**, respectively. The nylon wheels **100**, **102**, **104**, and **106** are supported by mounting blocks **110**, **112**, **114**, and **116**, respectively, which are secured to the carriage plate **78**. The wheels **100–106** all rotate about axes parallel with the axis of platen **12** and equally spaced from the plane of carriage plate **78**.

Each of the nylon wheels **100–106** is formed with a concave exterior surface contoured to engage approximately one-third of the circumference of the respective guide rail **90**, **92**, **94**, and **96**. The wheels **100** and **102** are positioned to engage the respective guide rails **90** and **92** from the side of the guide rail **90**, **92** closest to the platen **12**. The wheels **104** and **106** are positioned to engage the sides of the guide rails **94** and **96** from the side of those guide rails **94**, **96** most distant from the platen **12**. Thus the linear bearings **80–86** are constructed and arranged to provide for motion of the cartridge mounting plate **64** to which the rails **90–96** are connected in a direction perpendicular to the plane of the carriage plate **78** to which the nylon wheels **100–106** are connected and to resist movement in any other direction.

Movement of the cartridge assembly **18** (FIG. **2**) and cartridge mounting plate **64** between the two operating positions is achieved by means of a crank arm **120** connected with a rotatable square shaft **122** and solenoid assembly **124**. The square shaft **122** extends the length of and parallel to the platen **12** and rails **20** and **22** (see FIG. **1**) and is mounted at opposite ends in bearings **126** and **128** which are suitably connected with the printer **10**. The solenoid assemby **124** is fixed to the frame of the printer **10** at one end portion of the square shaft **122** and upon actuation causes the square shaft **122** to rotate.

The square shaft **122** extends through bearing blocks **134** and **136** (FIG. **4**) secured to the underside of the

carriage plate **78**. The two bearing blocks **134** and **136** (FIG. **4**) engage opposite sides of crank arm **120** and serve to position the axis of rotation of square shaft **122** with respect to the carriage plate **78**. Each bearing block **134** and **136** has a cylindrical passage **138** and **140**, respectively, therethrough coaxial with the square shaft **122**. Within each bearing block **134**, **136** is a bearing member **142** and **144**, respectively, which has a cylindrical outside surface received rotatably within the respective bearing block **134**, **136** and a square central passage through which the square shaft **122** extends. The bearing members **142** and **144** are restrained against axial movement by the end walls of the bearing blocks **134**, **136** in one direction and by retaining members **145** in the other direction. The fit of the central square passage through each of the bearing members **142**, **144** on the square shaft **122** is such that the bearing members **142** and **144** may slide easily along the square shaft **122**, yet with limited play in a direction normal to the axis of the square shaft **122**.

The crank arm **120** has a square central passage through which the square shaft **122** fits, and the crank arm **120** is positioned between the two bearing blocks **134** and **136**. When the carriage plate **78** moves along rails **20** and **22** transverse to the length of the platen **12**, the crank arm **120** follows. When the solenoid assembly **124** rotates the square shaft **122**, the crank arm **120** also rotates.

The crank arm **120** drives the cartridge mounting plate **64** through a bracket **160** which extends downward from the underside of the cartridge mounting plate **64**. The bracket **160** is fastened to the cartridge mounting plate **64**. The bracket **160** includes an oval slot **162** in the end portion of the bracket **160** remote from the cartridge mounting plate **64**. The slot **162** extends in a direction parallel to the plane of the cartridge mounting plate **64**. A pin **164** is press fit through a passage in the distal end portion of crank arm **120**, i.e., the end portion of crank arm **120** remote from the axis of the square shaft **122**. The pin **164** extends through the oval slot **162** in the bracket **160**. When the square shaft **122** rotates the crank arm **120**, the pin **164** presses against the walls of the slot **162** lifting or lowering the cartridge mounting plate **64** accordingly.

To achieve rotation of the square shaft **122**, the solenoid assembly **124** (FIGS. **1** and **2**) includes a solenoid **170** including a plunger **172** which is spring biased by means of spring **174** to an extended position. The solenoid **170** is in effect a motor. It can, of course, be replaced by equivalent motive mechanism, such as a stepper motor, a D.C. motor with limit switches and polarity/direction reversing circuitry, etc. The plunger **172** acts through an arm **176** which is fixedly connected with square shaft **122**. The arm **176** and plunger **172** include a slot **176A** and pin **176B** arranged similar to those used between bracket **160** and crank arm **120** so that when the solenoid **170** is actuated, the plunger **172** withdraws causing the crank arm **176** and square shaft **122** to rotate in a clockwise direction as viewed in FIG. **2**. Upon deenergization of the solenoid **170**, the plunger **172** extends biased by spring **174** to rotate the square shaft **122** in the opposite direction.

The limit of extension of the plunger **172** is adjusted by means of a threaded screw **180** which extends through a block **182** fastened to the frame **183** of the printer **10**. The screw **180** includes a pad **184** on its distal end portion which abuts the end of the solenoid plunger **172**. By adjusting the axial position of the screw **180**, the limit of travel in one direction of the solenoid plunger **172** may be adjusted. Suitable locking means **181** may be provided so that screw **180** will retain the position to which it has been adjusted.

In addition to the spring **174** which urges the plunger **172** outward and therefore urges the square shaft **122** to rotate in a counterclockwise direction, a spring **190** (FIG. **1**) is provided to further bias the square shaft **122** to rotate in a counterclockwise direction. The strength of the spring **190** is selected to counterbalance as nearly as possible the weight of the cartridge assembly **18**, cartridge mounting plate **64**, bracket **160**, and the guide rails **90–96** connected with the cartridge mounting plate **64**. By so counterbalancing the weight which must move up and down when the cartridge assembly **18** moves between its two operating positions, the work to be done by the solenoid assembly **124** is reduced and operation therefore accelerated.

As noted previously, the ribbon drive wheels **38** and **48** (FIG. **3**) are driven by a common ribbon drive shaft **60**. The ribbon drive shaft **60** is driven by an electric motor **200** carried in a suitable bracket **201** secured to the underside of the carriage plate **78**. The motor **200** drives a bevel gear **202** which in turn meshes with a bevel gear **204** which is connected with a shaft **206** coaxial with the ribbon drive shaft **60**. The shaft **206** is supported by suitable bearings **208**. Through the bevel gear arrangement the motor **200** can be conveniently placed with its axis of rotation horizontal while the axis of the ribbon drive shaft **60** is perpendicular thereto, and parallel to the direction of movement of the cartridge assembly **18** when it moves to change the ribbon **30**, **40** in the printing position.

The ribbon drive shaft **60** includes a tubular lower end portion including a central cylindrical passage **210** in which the shaft **206** is a sliding fit. A spring **212** acts between an end wall of the passage **210** and an end face of the shaft **206** urging te ribbon drive shaft **60** upward as viewed in FIG. **3** away from the shaft **206**. Rotary motion of the shaft **206** is transmitted to the ribbon drive shaft **60** by means of a pin **214** which is press fit through a passage **215** in shaft **206** and extends through a vertically extending slot **216** in the end portion of the ribbon drive shaft **60**. The vertical slot **216** in the tubular portion of ribbon drive shaft **60** therefore serves not only to tranmit torque but also to allow a limited axial movement of the ribbon drive shaft **60** with respect to the shaft **206**.

The ribbon drive shaft **60** includes a fluted portion **220** (FIGS. **5A** and **5B**) having an X or cross shaped cross section (FIG. **7**) which extends through a correspondingly shaped passage **222** (FIG. **7**) through the center of ribbon drive wheel **38**. The axial extent of the fluted portion **220** of the ribbon drive shaft **60** is such that when the cartridge assembly **18** moves between operating positions, the torque transmitting surfaces of the ribbon drive shaft **60** are always in contact with the internal surfaces of the passage **222** through the ribbon drive wheel **38**.

The uppermost end portion **228** of the ribbon drive shaft **60** may have the cross section shown in FIG. **6**, appearing approximately like a straight bladed screwdriver blade. The upper end portion **228** may also be merely a continuation of the fluted cross section of the lower portion **220**. The uppermost end portion **228** of ribbon drive shaft **60** is adapted to be received in a corresonding slot **230** (see FIGS. **5A** and **5B**) formed in the bottom of drive wheel **48**. The slot **230** may be

either a single straight slot as shown or it may be two slots positioned at right angles to each other. In any event, when the uppermost end portion **228** is received in the slot **230**, it will then transmit torque to the drive wheel **48** to pull the ribbon **40** unwinding it from the supply reel **42** and winding it onto the take-up reel **44**.

When the cartridge mounting plate **64** is in its upper operating position as illustrated in FIG. **2**, the fluted portion **220** of the ribbon drive shaft **60** is in engagement with the central passage **222** through the ribbon drive wheel **38** which pulls ribbon **30**. However, the blade **228** at the top of the ribbon drive shaft **60** is free of engagement with the slot **230** formed in the bottom of MICR ribbon drive gear **48** as shown in FIG. **5A**. Accordingly, the ribbon **40** is not driven when the cartridge mounting plate **64** is in the operating position shown in FIG. **2**.

When the solenoid assembly **124** is actuated to lower the cartridge mounting plate **64** and to bring the active portion of the MICR ribbon **40** into alignment with the printhead **16** and the platen **12**, the ribbon drive shaft **60** automatically engages the slot **230** formed in the bottom of the MICR ribbon drive wheel **48**. This occurs because as the cartridge mounting plate **64** is lowered, the drive shaft **60** is not lowered, and the blade **228** at the top of the ribbon drive shaft **60** comes into engagement with the bottom of the ribbon drive wheel **48** as shown in FIG. **5B**.

It may happen that as the cartridge **18** moves downward to bring the ribbon drive shaft **60** into engagement with the MICR ribbon drive wheel **48** that the blade **228** at the top of the ribbon drive shaft **60** is not in perfect angular alignment with the slot **230** formed in the ribbon drive wheel **48**. When this happens, the bottom of the ribbon drive wheel **48** will contact the upper end of the ribbon drive shaft **60** and press it downward, compressing the spring **212**. However, as soon as the motor **200** is actuated, the ribbon drive shaft **60** will rotate, bringing the blade **228** into proper angular alignment with the slot **230**, whereupon the spring **212** will cause the ribbon drive shaaft **60** to move upward. The blade **228** will then be in torque transmitting contact with the slot **230** formed in the bottom of the ribbon drive wheel **48**. When the solenoid assemby **124** is deactivated, the cartridge assembly **18** moves upward, automatically disengaging the MICR ribbon drive wheel **48** from blade **228**.

In operation, power is supplied to the printer **10** through conductor **250** (FIG. **1**) and control signals from a data processor **251** are fed to the printer through cable **252**. A motor **254** pulls on cable **256** in response to the control signals causing the carriage assembly **14** to reciprocate along the rails **20** and **22**. Simultaneously, pins (not shown) in the printhead **16** strike through the active portion of one of the ribbons **30** or **40**.

When printing in normal fonts, the dot matrix printhead **16** can form a complete line of characters with a single traverse of the carriage assembly **14** along the axial length of the platen **12**, and can do so while moving in either direction. After completion of each line, a motor **258** rotates the platen **12** to advance the web **11** an appropriate distance which depends upon the format of the matter being printed.

When the data processor **251** instructs the printer **10** to print MICR characters, the solenoid assembly **124** is actuated, pulling the cartridge assembly **18** into the second operating position in which the active portion of the MICR ribbon **40** is aligned between the printhead **16** and the platen **12**. The carriage assembly **14** is reciprocated by motor **254** as before, except that with MICR characters more than a single traverse of the carriage assembly **14** may be required to completely form the characters. Therefore, when printing MICR characters the platen **12** may not be rotated by motor **258** at the end of every traverse, but instead is rotated only after each line is completely printed.

The software required to actuate and control the platen drive motor **258**, the solenoid assembly **124**, the ribbon drive motor **200**, the carriage drive motor **254**, and the printhead **16** is not disclosed herein and does not form a part of the present invention. Moreover, it is believed that production of the necessary software is well within the skill of anyone of ordinary skill in the programming art, and for this further reason need not be set forth herein in detail.

Referring now to FIGS. **8** and **9**, computer program flow charts depicting operation of the present invention are illustrated. The flow charts are a shorthand notation representing software that could be used by a conventional computer **251** to drive the printer **10** in accordance with the present invention. A person having ordinary skill in the art would be able to reduce the computer program flow chart to appropriate computer language capable of operating such computer **251** to drive the printer **10** in accordance with the invention. The flow chart represents typical operation of the present invention.

Turning specifically to FIG. **8**, in block **260** power is turned on to the printer **10** and computer system. At block **261** conventional initialization routines are run; the nylon ribbon **30**, i.e. the non-MICR ribbon **30**, is shifted into position ready for use; the printhead **16** is at rest; and the ribbon drive motor **200** is off. At block **262** a self-test inquiry is made. For example, if there is any problem or reason to contemplate the possibility of a problem, then a selftest procedure represented at block **263** would be followed; if not, then at block **264** an inquiry is made whether data is to be printed. When data is to be printed, at block **265** an inquiry is made whether that data is to be MICR data. If negative, then normal printing function using the nylon, i.e. the non-MICR, ribbon **30** is carried out at block **266**. Normal printing routine would be the operation of the ribbon motor **200** to drive ribbon **30** through the printer **10** in the usual manner past the printhead **16** as the printhead **16** is printing.

If the inquiry made at block **265** is affirmative, then an inquiry is made at block **267** whether the printhead **16** is at rest. If affirmative, then at block **268** the ribbon motor **200** is stopped and a signal is provided to the solenoid **170** to effect rotation of the square shaft **122** to shift the ribbon cartridge assembly **18** to place the MICR ribbon **40** in alignment with the printhead **16**. If the printhead **16** is not at rest, then at block **269** the ribbon motor **200** is stopped, the printhead **16** is shifted to a turn-around location, and the MICR ribbon **40** is also shifted to proper position aligned with the printhead **16**. At block **270** a counter value N is made equal to 3 signifying readiness to effect printing using MICR ribbon **40**.

At block **271** an inquiry in made whether the first MICR character is less than or equal to 100 milliseconds away from the printhead location. If negative, then a loop is followed according to line **272** until the test is met. When the test is met, then line **273** is followed to block **274** in FIG. **9** turning on the ribbon motor **200** and accelerating the same and the MICR ribbon **40** to final

velocity. Printing then is carried out using the printhead **16** and the MICR ribbon **40**. At block **275** an inquiry is made whether the last character of a given line has been printed. If negative, then a loop is followed. When affirmative, then at block **276** the ribbon motor **200** is decelerated to stop the same, and the counter value N is decremented. At block **277** an inquiry is made whether the counter N equals zero. If negative, then line **278** is followed back to block **271** in FIG. **8**. However, if the counter N is zero at block **277**, then at block **279** the nylon or non-MICR ribbon **30** is shifted into alignment with the printhead **16**, and line **280** is followed back to block **264** in FIG. **8**. The counter N assures that no more than three lines are printed using MICR ribbon **40** unless a separate command is received from the data processor **251**. This characteristic saves MICR ribbon **40** from excessive use and can also be relied on to facilitate the printing of an MICR line using the printer **10** in three distinct passes in order to fill in the characters on a single line so that they appear as though printed with a solid type printer as opposed to a dot matrix type.

Using the present invention, then, media, such as checks, can be printed in an extremely convenient fashion. For example, the non-MICR ribbon **30** may be aligned with the printhead **16** selectively as desired, and the printhead **16** used therewith to print portions of the medium with non-MICR ink. At those areas of the medium that MICR characters are desired, when it comes time to print the same using the printhead **16**, the MICR ribbon **40** is shifted into appropriate alignment for printing using the dot matrix printer printhead **16**.

Most preferably the metod of the invention is carried out for printing bank checks, such as payroll checks and the like. A single supply of blank check forms can be provided to an automatic paper feeder in the printer **10**. The printer **10** then can print those portions of the check including the payer, payee, address information, tax information, witholding information, check amount, bank indentification, etc. using the non-MICR ink. The non-MICR ribbon **30** may be used for multiple passes by the printhead **16** without excessive wear. Those portions of the check which require magnetic coded information may be printed using the MICR ribbon **40** and ink. That information may be, for example, a bank identification number, customer account number, and check amount information. It will be appreciated that no further encoding or applying of MICR data to the check would be needed when the check is subsequently processed for payment, for example; thus, that additional labor step, the equipment required therefor, and the possibility of an error being made is eliminated. Importantly, elimination of that error possibility saves the labor having to find an error; such elimination is effected by printing the check amount using regular ink and using MICR ink during essentially a single pass of the check through a single printer **10**.

Although a preferred embodiment of the invention has been described, the scope of the invention is limited only by the claims which follow and not by the specific embodiment disclosed. Among the contemplated variations are the following. Although two ribbons **30, 40** have been described, one being treated with ordinary ink and the other being treated with MICR ink, it is contemplated that the two ribbons **30, 40** could differ only in the color of the ink used. Further, it is possible to utilize the present invention with a single ribbon **340** (FIG. **12**) having two parallel bands of ink thereon **342, 344**, one of one type and another of another type. The two types could be MICR ink and ordinary ink, or the two types could differ in color, or in some other way. Although the cartridge assembly **18** has been shown as made of two separate plastic pieces it could easily be of unitary construction.

Additionally, the ribbon drive assembly shown in detail in FIGS. **5**A and B and **6** continuously drives one of the ribbons **30** and selectively drives the other ribbon **40**. It is contemplated that this mechanism could be replaced with a drive mechanism **281** shown in FIGS. **10** and **11** in which similar numerals are used for similar parts. Where parts vary in detail but their overall function is the same as in the previously described embodiment, a prime (′) is appended.

The ribbon drive mechanism **281** drives only one ribbon at a time using the straight line movement of the carriage mounting plate **64** to not only engage the drive of one ribbon but to disengage the drive of the other. The upper ribbon drive wheel **48′** is identical to the lower ribbon drive wheel **38′**, and they are coaxially arranged. The ribbon drive shaft **60′** is cylindrical but has four symmetrical blades **282** extending radially outward therefrom. The blades **282** extend axially along the length of shaft **60′** a distance less than axial thickness of either drive wheel **38′** or **48′**. The blades **282** may engage the side walls of a correspondingly shaped passage **284** through drive wheel **48′** or the side walls of a correspondingly shaped passage **286** through drive wheel **38′**. The blades **282** may be beveled on the axial extreme edges as shown to facilitate engagement with passages **284** and **286**.

When the cartridge mounting plate **64** moves between operating positions, the blades **282** move between engagement with the side walls of passage **284** and those of passage **286**. The result is that only one ribbon drive wheel, **38′** or **48′**, is driven at one time.

When the cartridge mounting plate **64** moves, the blades **282** must engage one stationary drive wheel (**38′**) while that drive wheel (**88′**) is moving up and the other drive wheel (**48′**) when that drive wheel (**38′**) is moving down with respect to the blades **282**. The problem of non-alignment of the passages **284** and **286** is therefore doubled over the previously described embodiment. To accommodate this added difficulty a double acting spring assembly **290** is used to connect ribbon drive shaft **60′** with shaft **206**.

The spring assembly **290** allows axial movement of the ribbon drive shaft **60′** in either direction from a central position. To this end the ribbon drive shaft **60′** includes an axial, tubular extension **300** which may be integrally formed with the shaft **60′** or permanently connected thereto. A pair of axially extending and diametrically opposed slots **302** are formed in the walls of tubular extension **300** and slidably receive a pin **214′** which is press fit through a passage **215′** in shaft **206**. The pin **214′** transmits torque from shaft **206** through the sides of slots **302** to shaft **60′** while allowing axial movement of the shafts **206** and **60′** relative to one another.

An opposed pair of springs **306** and **308** bias the pin **214′** toward the axial center of the slots **302**. Spring **306** extends between an end wall **310** of the tubular extension **300** and a washer **312** circumscribing shaft **206** and bearing against pin **214′**. One end of spring **308** bears against a resilient retainer ring or circlip **314** received in a circumferential slot **316** in the lower end portion of the tubular extension **300**. The opposite end of spring

308 bears against washer 320 which is pressed thereby against pin 214.

When the cartridge mounting plate 64 shifts position, if the blades 282 are not properly aligned one of the springs 306 or 308 compresses, allowing the cartridge assembly 18' to move to the proper position. As shaft 206 starts to turn, blades 282 soon come into proper alignment and the compressed spring 306 of 308 then pushes the shaft 60' so that the blades 282 engage the walls of a corresponding passage 284 or 286.

Additionally, it is contemplated that the present invention could include more than two ribbons 30, 40. For example, the cartridge assembly 18 could be provided with three or more ribbons each with a different type of ink. Along these lines it is specifically contemplated that the cartridge assembly 18 could be provided with three different colored ribbons and a black ribbon so that with appropriate software it would be possible to print multicolored images. In this case a mechanism like the mechanism 281 could be used with the tubular portion 300 and springs 306 and 308 appropriately proportioned.

Thus it is clear that the present invention provides a printer 10 (FIG. 1) which can print selectively with either of two or more ribbons 30, 40 and a ribbon cartridge assembly 18 for use in such a printer 10. The printer 10 includes a conventional dot matrix printhead 16 and a rotatable platen 12. The printhead 16 is mounted on a carriage assembly 14 for reciprocating movement along a path parallel to the axis of the platen 12. The carriage assembly 14 also carries the ribbon cartridge assembly 18 which has a supply of two or more different ribbons 30, 40 an active portion of each of the ribbons 30, 40 being positionable between the printhead 16 and the platen 12 for printing on a web 11 or other sheet material.

The ribbon cartridge assembly 18 may include two ribbon supplies, one a supply of multi-strike ribbon 30 inked with ordinary ink and the other a supply of single-strike ribbon 40 inked with MICR ink. The multi-strike ribbon 30 is randomly stuffed in a cavity 32 in the lower portion of the cartridge assembly 18, and the active portion thereof is pulled past the printhead 16 by a pair of opposed drive wheels 37 and 38 frictionally engaging opposite sides of the ribbon 30.

The single-strike MICR ribbon 40 is supplied wound on a supply reel 42 and is wound onto a separate take-up reel 44 located between the supply reel 42 and the random storage cavity 32. The MICR ribbon 40 is pulled along a path with an active portion immediately above the active portion of the multi-strike ribbon 30. An opposed pair of drive wheels 48 and 50 pulls the MICR ribbon 40. One of the MICR drive wheels (48) is coaxial with one of the multi-strike ribbon drive wheels (38).

A ribbon drive is arranged to drive selectively at least one of the ribbon supplies. In practice, the MICR ribbon 40 is not driven when the printhead 16 is aligned with the active portion of the multi-strike ribbon 30. Instead, the MICR ribbon 40 is driven only when the printhead 16 is aligned with the active portion of the MICR ribbon 40 to print magnetically readable characters. The selective driving of the MICR ribbon 40 prolongs the time between ribbon cartridge changes.

A mechanism is provided for shifting the cartridge assembly 18 between a first operating position in which the active portion of one of the ribbons (30) is aligned between the printhead 16 and the platen 12 and a second operating position in which the active portion of the other ribbon (40) is so aligned. In cartridges having three or more ribbons, a corresponding number of positions are provided. The shifting mechanism provides for straight line movement, as opposed to a rocking or tilting movement, of the cartridge assembly 18 along a straight line path in the common plane of the active portions of the ribbons 30 and 40 and normal to a plane containing the platen axis, and this facilitates the selective drive of the MICR ribbon 40. Specifically, the drive wheel 38 for the multi-strike ribbon 30 is driven by a fluted shaft 60 which extends through the center thereof. The multi-strike ribbon drive wheel 38 is axially slidable along the shaft 60 as the cartridge 18 shifts between operating positions. In one of the operating positions (FIG. 5B) the shaft 60 engages and drives the drive wheel 48 for the MICR ribbon 40 as well as the multi-strike ribbon drive wheel 38. In the other operating position, the shaft is free of contact with the MICR ribbon drive wheel 48 and so does not drive it. In this way movement of the cartridge assembly 18 between operating positions automatically engages and disengages drive to the more expensive and nonreusable MICR ribbon 40.

The arrangement of the components is also designed to minimize the mass which must move when shifting between one operating position and the other and to minimize the mass that reciprocates with the carriage assembly 14 along the length of the platen 12 as each line is printed. The ribbons 30 and 40 are both driven by a single electric motor 200 which is connected to the reciprocating carriage assembly 14. This motor 200 does not move when the cartridge assembly 18 is shifted between operating positions. Instead, the cartridge assembly 18 moves up and down sliding on the ribbon drive shaft 60 which is driven by the electric motor 200. This not only selectively engages and disengages the MICR drive wheel 48 as discussed above, but also allows reduced weight by using only a single motor 200 and promotes faster shifting between operating positions because the motor 200 itself does not move.

The cartridge assembly 18 is shifted between operating positions by a solenoid 170 which is remote from the cartridge assembly 18. The solenoid 170 is fixed to the printer frame 183 and, through a crank arm 176, rotates a square shaft 122. The square shaft 122 in turn operates a second crank arm 120 which is slidable along the shaft 122 as the carriage assembly 14 moves. The cartridge assembly 18 is mounted on linear bearings 80, 82, 84, and 86 in the carriage assembly 14 and moves up and down in a straight line path when the second crank arm 120 is rotated by actuation of the solenoid 170. The remote mounting of solenoid assembly 124 reduces the reciprocating mass of carriage assembly 14 along the rails 20 and 22 with attendant advantages in speed, reduced vibration and longer wear.

The shift mechanism of the invention may be provided as a conversion kit for modifying existing printers to give them the capability of use with multiple ribbons, as aforesaid.

The following is claimed:

1. A cartridge and drive assembly for use with a printer having a frame and an axially reciprocatable print head, the improvement comprising ribbon cartridge means for containing a plurality of bands of inked ribbon, means for supporting a portion of each of said bands of inked ribbon in a common plane, and means for shifting said cartridge means along a straight line path between a first position in which one of said bands of

inked ribbon is aligned for printing and a second position in which another of said bands of inked ribbon is aligned for printing, carriage means for supporting said ribbon cartridge means, said carriage means and ribbon cartridge means being movable with said print head, and said means for shifting comprising a shaft fixed against axial movement, rotatably mounted in fixed position relative to said frame, and extending axially parallel to the axis of reciprocation of said print head, motive means for producing a mechanical output to effect shifting, said motive means being mounted fixed to said frame against reciprocation with said carriage means and being coupled to said shaft to rotate said shaft to effect shifting, a crank arm axially slidable along said shaft and fixed against rotation relative to said shaft, and means for connecting the distal end portion of said crank arm with said ribbon cartridge means to effect movement of said ribbon cartridge means along the straight line path upon rotation of said shaft, and said carriage means including means for positioning the axis of said shaft with respect to said carriage and for positioning said crank arm with respect to said carriage.

2. The cartridge and drive assembly of claim **1**, wherein said motive means includes a solenoid, and a second crank arm fixedly connected with said shaft, said solenoid being connected with said second crank arm.

3. The cartridge and drive assembly of claim **2**, wherein said shaft is polygonal.

4. The cartridge and drive assembly of claim **2** wherein said shaft is square.

5. The cartridge and drive assembly of claim **1** wherein said ribbon cartridge means includes means for containing a plurality of separate ribbons.

6. The cartridge and drive assembly of claim **5** further including means movable with said carriage means for selectively driving said ribbons.

7. The cartridge and drive assembly of claim **6**, wherein said means for selectively driving includes a drive wheel associated with each of said ribbons, a motor driven shaft, said motor driven shaft having torque transmitting surface means for engaged surfaces on one of said drive wheels when said cartridge means is in selcted position along said straight line path and wherein said motor driven shaft is axially movable and biased in at least one axial direction to a predetermined axial position.

8. The cartridge and drive assembly of claim **7** wherein said means for selectively driving one of said ribbons includes motor means fixed with respect to said straight line movement of said cartridge means between said operating positions for driving said motor drive shaft.

9. The cartridge and drive assembly of claim **7** wherein one of said ribbons is inked with MICR ink.

* * * * *